REMARKS

Claim 6 has been revised. The revision to claim 6 is supported by, for example, page 5, lines 1-4 and page 10, lines 24-28 in the Specification. There is no new matter. Claims 5-11 are pending. Applicants respectfully request a favorable reexamination and reconsideration of the claims.

Claim Rejections - 35 USC § 112

Claim 6 was rejected under 35 USC 112, first paragraph, for failing to comply with the written description requirement. Claim 6 has been revised to address the Examiner's concern. Applicants do not concede the correctness of the rejection. A withdrawal of the rejection is requested.

Claim Rejections - 35 USC § 103

Claims 5 and 7-11 were rejected under 35 USC 103(a) as being unpatentable over Chambers (US 6126794) in view of Switzer (US 4663004). The rejection conceded that Chambers fails to teach electrodes comprising a semiconductor. The rejection stated that Switzer teaches electrodes made of a semiconductor material in order to increase application of electrochemical cell and therefore one of ordinary skill in the art would have been motivated to use the semiconductor electrodes, as taught by Switzer, in the electrochemical apparatus of Chambers. Applicants respectfully disagree.

Chambers purports to teach an apparatus that overcomes many undesirable features of a conventional electrochemical cell device. For example, Chambers teaches that a conventional pair of electrodes is made of two different materials, but that it would be desirable to construct the electrodes using the same material (column 1, lines 15-16 and lines 36-38). Chambers also teaches that a conventional cell adds undesirable chemical catalysts into the water but that it would be desirable to use only "regular" tap water without addition of chemicals (column 1, lines 21-24 and lines 33-35). In order to overcome at least the above purported undesirable characteristics of a conventional electrochemical cell device, Chambers teaches an apparatus for producing hydrogen from "regular" tap water using a pair of electrodes that are made of the same material, such as stainless steel (column 3, lines 48-49).

In contrast to Chambers, Switzer teaches that the "electrode used in the invention is typically employed at the cathode" and a "counter electrode such as platinum metal is employed at the anode" (column 3, lines 9-12). Although Switzer does not exclude a counter electrode

containing some semiconductor material, Switzer does not teach using the same electrode both as a cathode and an anode. Switzer teaches many examples and advantages wherein the cathode and anode contain different materials. Switzer reports the disadvantage of using electrodes made of the same material (platinum) stating a lackluster outcome of "only about 0.2 ml of gas" being collected (column 7, line 66 to column 8, line 6). Further, the device as taught in Switzer requires that the liquid contain an electrolyte and at least one redox-couple so that "a direct electric current from the electrode to at least one electrolyte component and/or at least one redox-couple in the electrochemical cell" (column 3, lines 14-24).

Accordingly, Chambers and Switzer teach contradicting features and purported advantages of those features. Chambers teaches an apparatus requiring a pair of electrodes made of the same material immersed in water without any added chemicals. In contrast, Switzer teaches a pair of electrodes made of different materials immersed in water with added chemicals. Each reference explicitly states that that the features taught by the other are not desirable. Accordingly, it is unreasonable to conclude that there is motivation to combine the apparatus of Chambers with electrodes of Switzer. Such combination relies only on impermissible hindsight benefiting from the Applicants' disclosure. Thus, the electrode as taught in Switzer and the apparatus as taught in Chambers are not combinable.

Further, the rejection stated that it is well known in the art to configure the electrodes in such a way that they are exchangeable connected to the positive and negative terminals. Applicants respectfully disagree. Neither Chambers nor Switzer recognized the problem of electrode material consumption after a prolonged use of their devices. As stated in the Specification, after a prolonged use of electrodes, it has been observed that hydrogen gas generation stops after about 30 hours (see page 13, lines 25-28 in the Specification). Chambers teaches that the only way to increase the amount of hydrogen gas and oxygen gas generated in its device is to increase the number of electrodes in the apparatus (see column 5, lines 21-23, stating "with sufficient electrodes [the device] can generate hydrogen and oxygen fast enough to feed the gases directly into an [engine]"). Further, Switzer explicitly teaches that this exchangeable connection does not occur in Switzer's apparatus. Switzer teaches that the alternating current is rectified (see Abstract of Switzer). Rectification changes alternating current (AC) to direct current (DC). Accordingly, Switzer's apparatus does not change the direction of the electric current flowing between the electrodes. Thus, in Switzer's apparatus, there is no exchangeable

connection to positive and negative terminals. In contrast, claim 5 requires that the electrodes are interchangeable connected to a positive terminal and a negative terminal which advantageously causes suppression of electrode material consumption. Advantageously, features of claim 5 allows for exchange of the electrode materials between the electrodes so that the production of hydrogen gas was observed after about 100 hours (see page 13, lines 30-32 in the Specification; compare to the 30 hour limits discussed on page 13, lines 25-28). Therefore, Chambers and Switzer do not teach at least this feature of claim 5.

Further, Chambers and Switzer both teach devices that break down water molecule (H_2O) to hydrogen gas (H_2) and oxygen gas (O_2) at the same time. Neither Chambers nor Switzer teaches a device that selectively generates hydrogen gas (H_2). Chambers teaches that "the electrodes continuously and almost instantaneously generate hydrogen and oxygen bubbles from the water" (column 4, lines 52-54) and that "only tap water is needed for generation of the hydrogen and oxygen in the present invention" (column 4, lines 64-65). Further, Chambers teaches that both hydrogen gas (H_2) and oxygen gas (O_2) produced from the apparatus are not stored, but fed directly into an internal combustion engine or turbine engine to run the engine continuously (column 5, lines 21-27). Thus, Chamber's device breaks down water (H_2O) to molecular hydrogen gas (H_2) and molecular oxygen gas (O_2) and then the gases are fed directly to an engine where hydrogen gas (H_2) and oxygen gas (O_2) react in an exothermic reaction, producing water molecule (H_2O) back again. Chambers also teaches that "an optimal amount of hydrogen and oxygen" are produced (column 5, lines 7-8). Such an optimal amount of hydrogen gas to oxygen gas would be a ratio of 2 hydrogen gas molecules for every 1 oxygen gas molecule (from the stoichiometric ratio of hydrogen atoms to oxygen atom in H_2O). Even further, Chambers teaches that this H_2/O_2 ratio of 2:1 is required to have an optimal amount of both gases so that the gases are not accumulated thus requiring storage (column 5, lines 24-25). Similarly, Switzer teaches that the "hydrogen/oxygen ratio throughout the operation of the cell is 2.07 + 0.04" (column 7, lines 51-53). Switzer also teaches that hydrogen gas is collected at the cathode while oxygen gas is collected at the anode at a 2:1 ratio (see column 7, lines 62-65). Thus, the devices taught in Chambers and Switzer are not designed to be nor capable of selectively generating hydrogen gas by activating hydrogen atoms. In contrast, the present invention has results that are unexpected according to the teachings in Chambers and Switzer. For example, present invention produces much greater quantity of hydrogen gas than oxygen gas. As

illustrated in Figs. 3(a) and 3(b) in the Specification, when gas produced are collected by a method of collecting a gas over water (as it is known in the art that the gases collected according to this method are collected at the same temperature and pressure), the hydrogen was produced at the negative electrode side and after 6.0 hours, 63.51 ml of H_2 was produced as compared to 4.98 ml of O_2. This result is clearly not a sustained 2:1 ratio as taught in Switzer. This result is clearly not an "optimal" ratio as required in Chambers. Further, the result of hydrogen gas being produced at the negative electrode is also unexpected according to the teachings of Chambers. Further, the amount of O_2 generated was close to the amount of N_2 gas produced (3.34 ml). N_2 gas does not result from breakdown of H_2O molecule. Accordingly, the results illustrated in Figs. 3(a) and 3(b) are unexpected according to Chambers and Switzer. Even more, the unexpected results of the present invention would make Chambers' device from working as intended because the ratio of hydrogen gas to oxygen gas is not an "optimal" ratio that can be fed directly into an engine without the necessity of storing the gases. Thus, Chambers teaches away from the unexpected results of the present invention.

Accordingly, Chambers in view of Switzer do not teach or suggest all of the required features of claim 5. Thus, for at least the above reasons, claims 5 and its dependent claims 6-11 are patentable over Chambers in view of Switzer. Applicants respectfully request a withdrawal of the rejection.

Claim 6 was rejected under 35 USC 103(a) as being unpatentable over Chambers and Switzer and further in view of Wang et al. (US 6800386). Wang et al. does not remedy the deficiencies of claim 5 stated above. Accordingly, claim 6 is patentable for at least the same reasons as claim 5 from which it depends.

Further, Applicants respectfully disagree that Wang et al. teaches the required voltage and current ranges of claim 6. The rejection conceded that Chambers in view of Switzer fails to teach using a pulse electric power having the claimed voltage and current ranges. The rejection erroneously concluded that Wang et al. remedies this deficiency.

Wang et al. teaches a fuel processor having a reactor 18 and a precombuster 1060 (see Fig. 1). The precombuster 1060 has a high voltage electrical discharge device 1074 used to heat a gas within the precombuster, wherein the temperature of the gas is raised forming "primarily of carbon dioxide and steam" and "less than 5 molar percent of hydrogen" (column 5, lines 53-62).

The heated gases from the precombuster are then conveyed to the reactor 18, wherein hydrogen generation occurs, resulting in "at least about 50 molar percent of hydrogen" (column 6, lines 8-9).

An electrical discharge device, used in a precombuster filled with a gas, wherein the discharge device heats up a gas, is not an analogous structure to a pair of electrodes immersed in water or a liquid of hydrogen-containing organic compound, wherein a pulse electric power generated between the first electrode and the second electrode activates hydrogen atoms contained in the water or the liquid to produce hydrogen gas. Accordingly, the voltages and current accredited as being a combinable feature is a feature of a non-analogous structure to that being claimed. Thus, the voltages and current disclosed in Wang et al. is not applicable to the claimed structures.

Further, Wang et al. does not teach using the electrical discharge device in a liquid. Wang et al. does not teach using the electrical discharge device in generating hydrogen gas from a liquid. Wang et al. also does not teach that the voltages and current used in their device can be used for activating hydrogen atom from a liquid or water in the reactor. The reactor of Wang et al. is intended to use a gas, not a liquid.

Thus, it is unreasonable to conclude it would one of ordinary skill in the art would combine the teachings of Wang et al. with the teachings of Chambers and Switzer. The teachings of Wang et al. and the teachings of Chambers and Switzer are not combinable. Even if the teachings could be considered to be combinable, which Applicants are not conceding, such a combination relies on impermissible hindsight benefiting from the Applicants' disclosure. Therefore, Wang et al. does not teach at least this feature. Claim 6 is patentable over Chambers in view of Switzer in further in view of Wang et al. Applicants respectfully request a favorable reexamination and reconsideration of the claim.

In view of the above, early issuance of a notice of allowance is solicited. Any questions regarding this communication can be directed to the undersigned attorney, Curtis B. Hamre, Reg. 29,165, at (612)455-3802.

Respectfully submitted,

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